ESA STSE “SST Diurnal Variability: Regional Extend - Implications in Atmospheric Modelling”

Karagali, Ioanna

Publication date:
2016

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):
Karagali, I. (2016). *ESA STSE “SST Diurnal Variability: Regional Extend - Implications in Atmospheric Modelling”*. Poster session presented at ESA Living Planet Symposium 2016, Prague, Czech Republic.

ESA STSE “SST Diurnal Variability: Regional Extend - Implications in Atmospheric Modelling”

Ioanna Karagali

DTU Wind Energy, Risø Campus, Roskilde, Denmark

DTU Wind Energy
Department of Wind Energy

Introduction

The diurnal variability of SST, driven by the coincident occurrence of low enough wind and solar heating, has been observed in various regions of the global ocean [4, 5, 6]. Atmospheric, oceanic and climate models are not adequately resolving the daily SST cycle, resulting in biases of the total heat budget estimates and demised model accuracies [2, 1]. The ESA STSE project SSTDV:R.EX.-IM.A.M. focused on different aspects.

Characterising the regional extend of diurnal SST signals in the Atlantic Ocean and the European Seas.

Using the General Ocean Turbulence Model (GOTM) to resolve the vertical temperature structure.

Examining the impact of diurnal SST signals on atmospheric modelling, using the Weather Research & Forecasting (WRF) model.

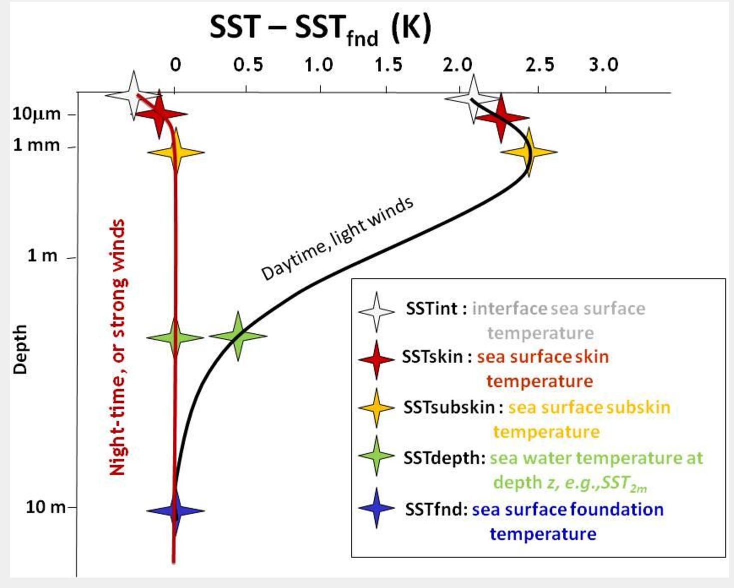


Figure : Near surface temperature gradients [7].

Challenges

- Impact on air-sea fluxes, atmospheric stability
- Complications for multi-sensor SST
- SST time-series
- Atmospheric model outputs
- SST retrieval algorithms
- Wind retrieval algorithms

Regional diurnal warming

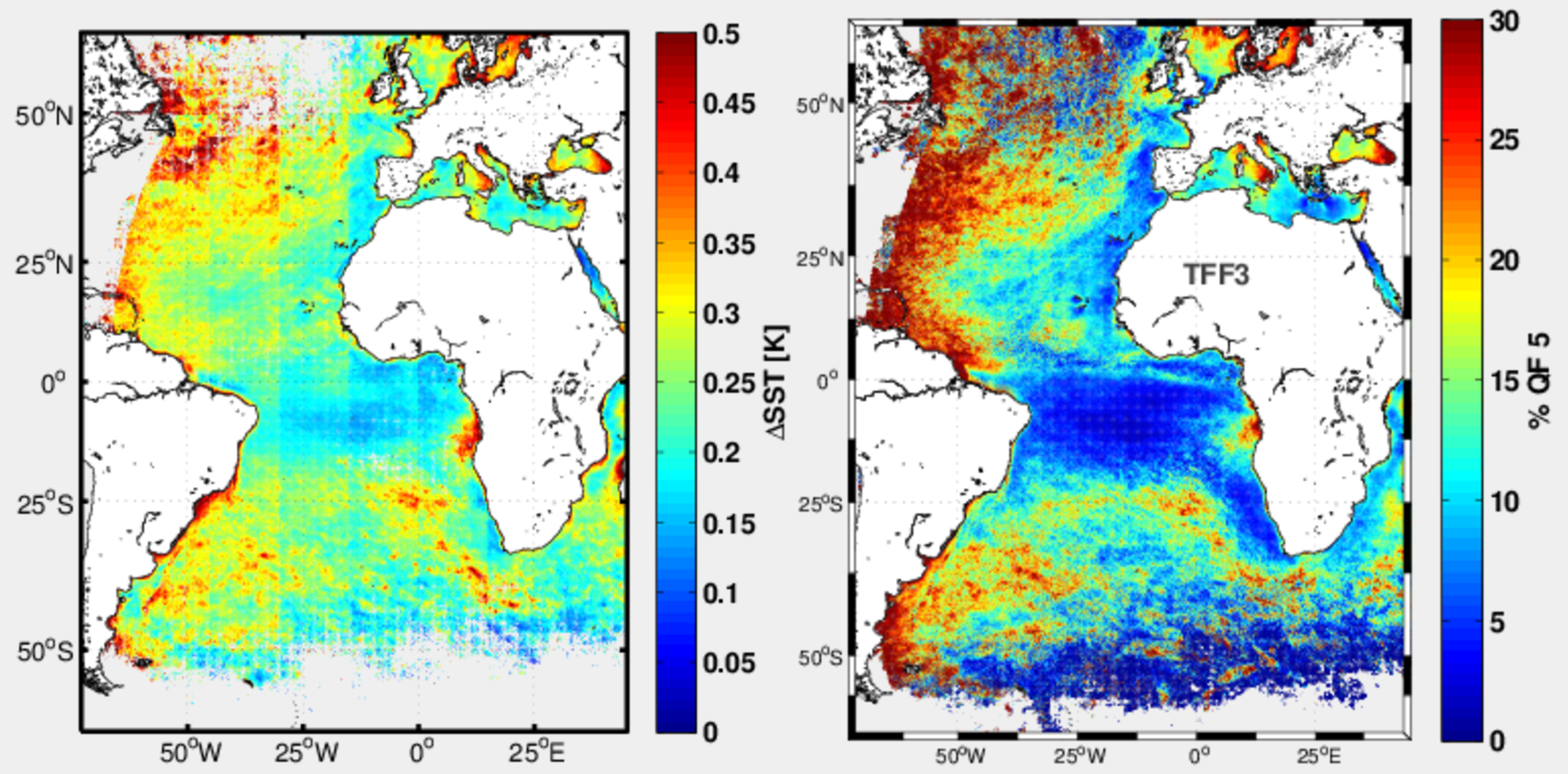


Figure : Maximum mean monthly warming (left), SST_{day}-SST_{found}, and % of quality 5 (best) observations available for 2006-2011.

SST in WRF

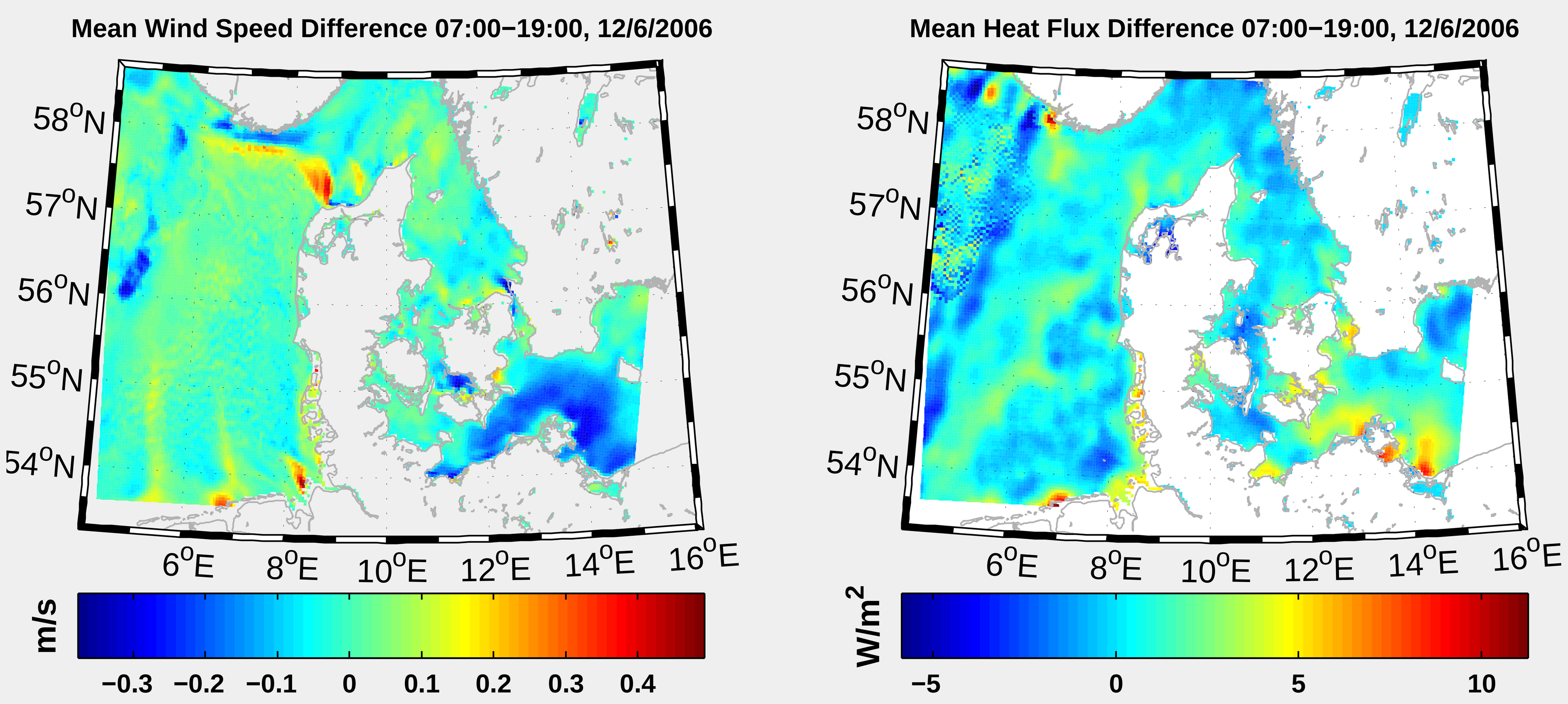


Figure : Mean wind speed (left) and surface heat flux (right) difference between the WRF runs with 6-hourly SST updates and the daily SST, during day-time (07-19) on 12/06/2006.

Conclusions

This study describes the spatial and temporal character of the upper ocean’s diurnal temperature variability. To bridge the gap between satellite SST and in situ measurements the GOTM model was used to reproduce the temperature observed from buoys at the depths of 1 m and 2 m but also from SEVIRI SST. The vertical temperature structure down to 140 m, was reasonably resolved (within 0.5°C). Different long-wave radiation parametrisations resulted in modelled temperatures with a difference of ∼0.1–0.2°while light extinction schemes caused a ∼1°difference in modelled temperatures. Regarding the temporal resolution of SST in WRF, for the simulated (eight in total), independent of the time period for the simulation (one day or three days), an average increase of up to 20% in the wind speed and even up to 40% (or more) in the heat flux was identified during the day time period (07:00-19:00) when the SST in WRF was updated every six hours, compared to using one daily value.

Modelled diurnal signals

Arkona Becken

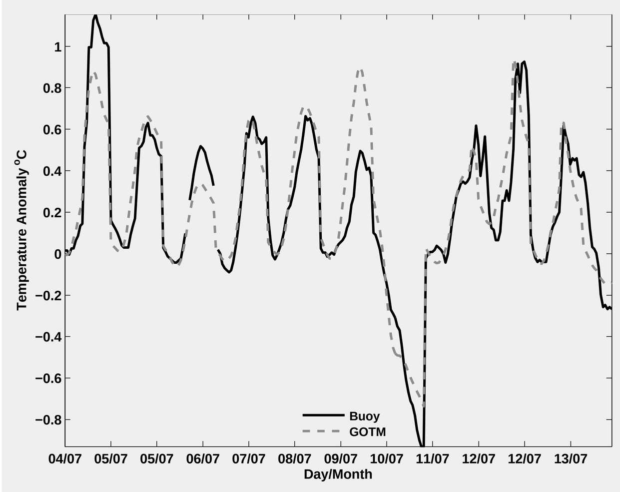


Figure : Diurnal variability at 2 m depth from July 4th to 14th, 2013.

PIRATA

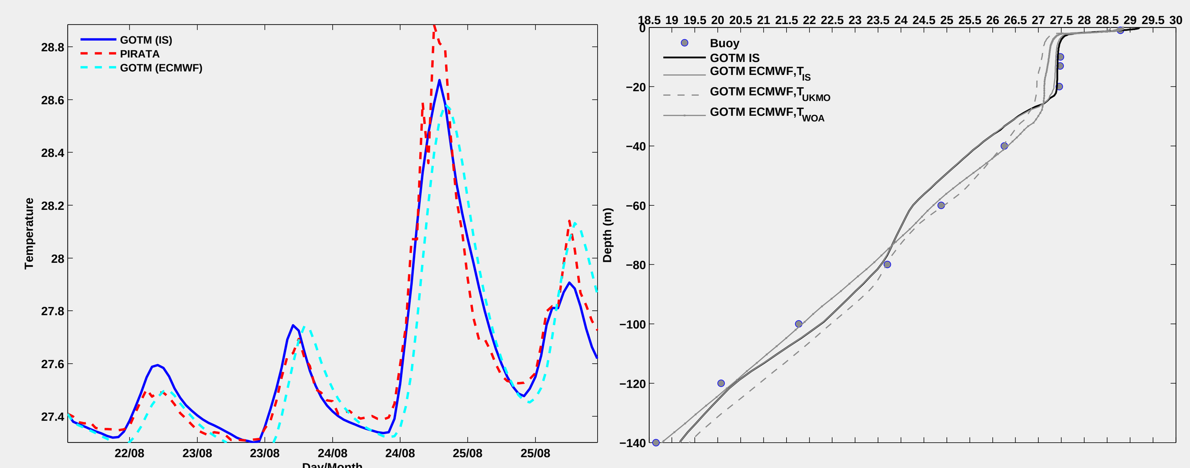


Figure : GOTM with in situ meteo+profile, ECMWF meteo+in situ profile. Right: PIRATA measurements, GOTM runs for the peak day-time temperature on 24/08/06.

Large DV Events

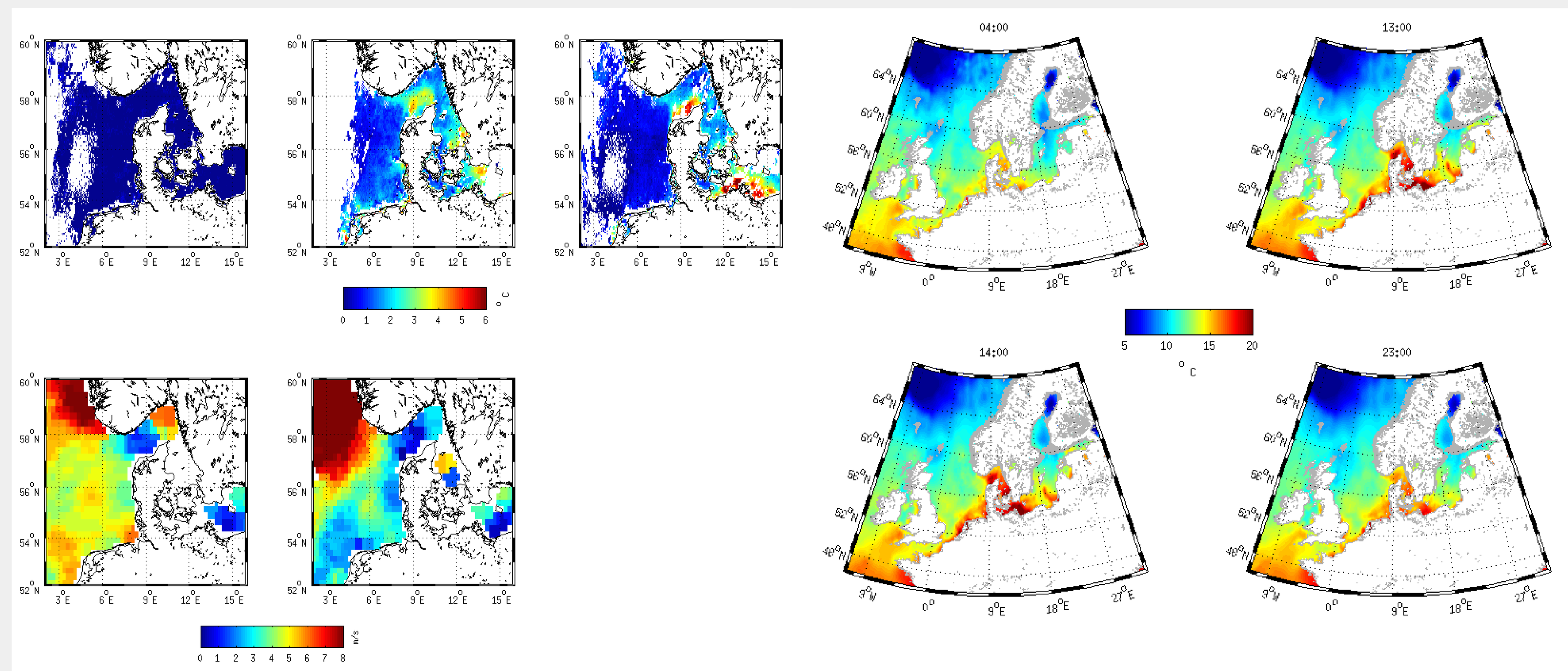
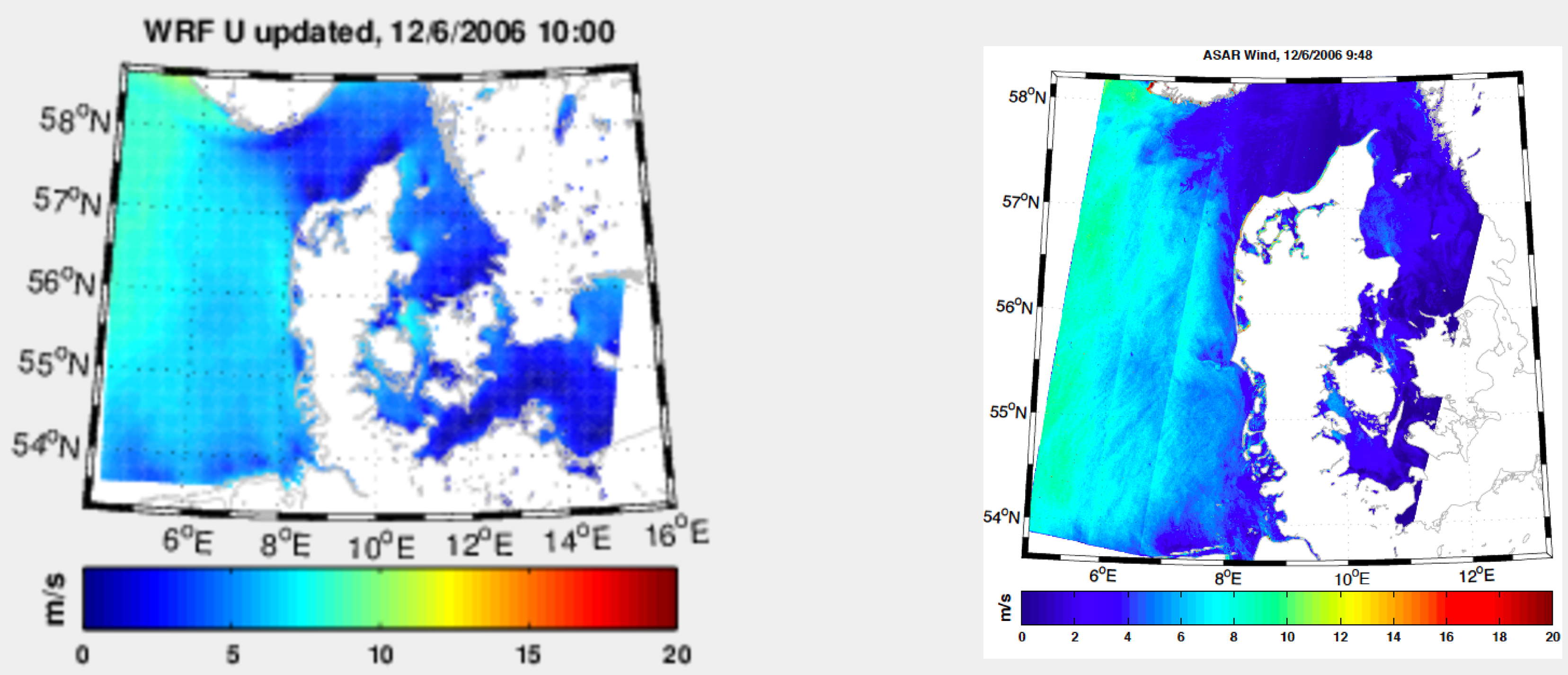


Figure : A large event identified from SEVIRI (top left) with wind speed from QuikSCAT (bottom left) and the OI SST fields (right) from the hourly SEVIRI SST [3].

WRF & ASAR 10 m Winds



Acknowledgements

European Space Agency (ESA) Support To Science Element (STSE), Danish PSO X-WiWa project, New European Wind Atlas project. SEVIRI data from Centre de Météorolgie Spatiale, Météo France & OSI-SAF project. The WHOI UOP Group, the TAO Project Office of NOAA/PMEL for PIRATA, the BSH Institute MARNET network for Arkona Becken, O&SI-SAF, the MyOcean project, NODC, the UKMO Hadley Centre.

References

[1] Bernie, D. J.,Guilyardi, E., Madec, G., Slingo, J. M., Woolnough, S. J., and Cole, J.: Impact of resolving the diurnal cycle in an ocean-atmosphere GCM. Part 2: a diurnally coupled CGCM. Clim. Dyn. 31, 909–925, 2008.

[2] Clayson, C. A., and Bogdanoff, A. S.: The effect of diurnal sea surface temperature warming on climatological air–sea fluxes. J. Clim. 26, 2546–2556, 2013

[3] Høyer, J. and She, J: Optimal interpolation of sea surface temperature for the North Sea and Baltic Sea, J. Mar. Sys. 65 (1-4), 176–189, 2007.

[4] Karagali, I. and Høyer, J.: Characterisation and quantification of regional diurnal SST cycles from SEVIRI, Ocean Science 10, 745–758, 2014.

[5] Karagali, I. and Høyer, J.: Observations and modelling of the diurnal SST cycle in the North and Baltic Seas, J. Geophys. Res.-Oceans 118 (9), 4488–4503, 2013.

[6] Karagali, I., Hoeyer, J., and Hasager, C. B.: SST diurnal variability in the North Sea and the Baltic Sea, Remote Sens. Environ., 112, 159–170, 2012.

[7] Minnett, P., and Kaiser-Weiss, A.: Near-surface oceanic temperature gradients, GHRSST Discussion document, 2012.

(1)ioka@dtu.dk